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REVIEWS.

The Glacial Lake Agassiz. By WARREN UPHAM. Monograph of the United States Geological Survey, Washington, D. C., 1895.

This *opus magnum* of one of our most active and worthy glacialists has fallen between the two horns of a dilemma common enough in the experience of the busy editor who hesitates between the hasty sketch which alone time permits him to prepare and the careful review which he knows he ought to prepare in due respect for the merits of the work. The choice of the latter which best suits the stress of the hour too often proves but a renewal of the dilemma with added intensity when he next recurs to the subject, and so the struggle goes on until the alternative narrows to an inadequate notice or an unworthy negligence of a work of merit.

This monograph of more than 650 pages, amply illustrated by maps and diagrams, represents several years of very industrious study of the surficial phenomena of the basin of the Red River of the north and adjacent territory, begun under the auspices of the Minnesota Survey and finished under those of the United States Survey with the coöperation of the Canadian Survey.

The treatment is systematic and detailed. Beginning with a general introduction it passes to the topography of the basin which is minutely described, after which the underlying formations embracing the Archæan, the two Silurians, and the Cretaceous, are discussed at some length. The glacial period and its drift deposits are treated with still more fullness because of their immediate relations to the history of Lake Agassiz. This is introduced by a review of the glacial period in North America, and a comprehensive sketch of the continental ice-sheet which is illustrated by an excellent map showing not only the general distribution of North American Pleistocene glaciation as known at the time of its preparation, but also the directions of movement in various parts of the great area. Greenland

and the Archipelago north of the continent are included. The Laurentide and Cordilleran ice-sheets are differentiated and the debatable belt between them indicated. The Keewatin ice-sheet which has since been differentiated from the Laurentide glacier in part at least by Tyrrell is, of course, not separately represented. The recession of the ice-sheet and the courses of the ice movement in the immediate vicinity of Lake Agassiz are very fully set forth, as well as the drift deposits of the region. The succession of terminal moraines is amply delineated by text and maps. The moraines from the seventh or Dovre to the eleventh or Mesabi are regarded as contemporaneous with Lake Agassiz.

With this very ample but needful introduction the history of Lake Agassiz is delineated. A distinction is drawn between the Great Basin lakes, Bonneville, Lahontan, and others, and true glacial lakes of the Agassiz type. The indubitable evidences of the existence of the lake in a well-cut outlet, eroded cliffs, beaches, deltas, and lacustrine deposits, are set forth in general terms at the outset and taken up in much detail afterwards.

The contemporaneity of the great ice-sheet and the dependence of the lake upon the ice mass for its northern barrier is a central point of interest in the monograph. The changes in the history of the lake are made dependent upon the shifting position of this ice barrier, upon the erosion of the outlet, and upon progressive changes in the earth's surface. An attempt is made to measure the duration of Lake Agassiz by means of its beaches, its moraines, and correlated phenomena, with the result that the period is believed to have been short and the formation of the moraines very rapid. Some alternative interpretations by Chamberlin, under whose direction the work was prosecuted, are introduced at this point at the request of the author, the chief purport of which is to assign a series of rising as well as falling stages to the shores of Lake Agassiz and to thereby make the moraines antedate the highest beach and to leave the time occupied in their formation undetermined.

The beaches are divided into two classes, the one set being those connected with the southern outlet at Lake Traverse and the other set those connected with some undetermined outlet to the northward. Five distinct stages, represented by as many beaches or groups of beaches, belong to the first set and four to the second. One of the most important features of the monograph is the accurate determina-

tion of very notable changes in the level of these beaches. A former relative rise of the surface to the northeast is not only amply demonstrated, but a progressive fall of the surface at the north at later stages until it reached its present attitude is fully made out. The movement appears to have been steadily progressive and systematic. The possible causes of these changes of levels are discussed, embracing gravitation toward the ice-sheet which, while measurably effective, is found quantitatively insufficient, changes in the temperature of the earth's crust which is also regarded as insufficient, and epeirogenic movements apparently dependent in part upon glaciation, which is regarded as the essential agency. In this connection the author extends his discussion widely, treating of the preglacial elevation of North America, as shown by fiords and submarine valleys and of the late glacial or Champlain submergence shown by fossiliferous marine beds overlying glacial deposits, and from these he endeavors to deduce the Pleistocene oscillations embracing those which were independent of glaciation as well as those dependent upon it. He maintains his well-known views regarding the dependence of glaciation essentially upon epeirogenic movements.

The monograph closes with chapters on the artesian and common wells of the Red River valley and the agricultural and mineral resources of the area of Lake Agassiz. There are added appendices giving the courses of glacial striæ and notes on aboriginal earth works within or near the area of the lake. The whole material is worked out with care and great detail and constitutes a very important contribution to Pleistocene history in both its glacial and its lacustrine aspects.

T. C. C.

Catalogue of the Tertiary Mollusca in the Department of Geology, British Museum (Natural History). Part I. The Australasian Tertiary Mollusca. By GEORGE F. HARRIS, F.G.S. 407 pp., 8 pls. London, 1897.

The British Museum, which has in process of publication catalogues of its great collections, has lately started a new series upon the Tertiary Mollusca, under the editorship of Professor Harris. The first volume dealing with the Australasian forms has just made its appearance. The acquisition by the Museum at different times since